# Developing Small Form-Factor MicroATX Systems

Greg Schlechter
Senior Technical Marketing Engineer
Desktop Products Group
Intel Corporation

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## Overview

As the PC market segment continues to mature and expand into new applications and usage models, new system profiles and configurations are emerging. A recent focus is small, quiet systems that blend into environments such as a crowded office desktop or home living room. At the same time, users are demanding high-performance components in these small systems, creating unique design and integration challenges for developers who prefer to use standard components for cost and inventory reasons.

To help developers meet the growing demand for these small form-factor systems, a number of new design guides have been published as part of the Intel program code-named Tidewater and are available at the Desktop Form Factors Web site. This article presents some of the key points covered in those guides and presents an overview of several techniques for and considerations when using the microATX form factor in small form-factor systems.

## What is microATX?

As a leader in establishing desktop system form factors, Intel introduced microATX in 1997 as a natural evolution of the ATX form factor. While offering the same benefits as the ATX form factor, such as increased I/O space at the rear and reduced emissions (from using integrated I/O connectors), the microATX form factor also addressed the specialized needs of developers of smaller tower systems.

In recent years, microATX has become the form factor of choice for use in microTower systems, typically 20–25 liters in volume. Now, developers are finding they can use this same board form factor for even smaller system profiles, down to 10 liters in volume (and sometimes smaller). This means OEMs (original equipment manufacturers) and integrators can use familiar design techniques and the same motherboard inventory for their mainstream microTower product lines and their (lower-volume) small form-factor lines.

## Key Considerations in the Design of Small Form-Factor Systems

Developers face unique considerations and design requirements when designing a microATX small form-factor system (10–15 liters). Key among them are limited space in the rear panel, requiring the system fan to be located in the front or side of the system, and limited space for natural airflow, requiring more care in establishing airflow patterns.

As with a microTower design, developers must assemble a system that will stay both cool and quiet while limiting EMI emissions and maintaining performance at a competitive cost. The key considerations in achieving this goal are to maximize airflow volume and minimize airflow impedance while minimizing acoustic noise. To do this, designers typically employ a number of techniques.

To maximize airflow and minimize airflow impedance, developers can:

- Use ducting to direct cool air to the processor with minimal impedance and temperature rise.
- Maximize vent and bezel openings along desired airflow paths. To do this while simultaneously minimizing EMI emissions, developers can employ a technique known as Wave Guide Venting, which utilizes added depth of the venting structure to contain EMI while allowing for larger airflow openings. A reasonable target is a 70 percent free area ratio for the front and rear vents. (For more information on designing Wave Guide Venting, go to the Desktop Form Factors Web site.
- Use a system fan to provide the necessary overall system airflow. As in microTower design, the power supply usually can not be relied on to adequately evacuate enough air and a dedicated system fan should be used.

To minimize acoustic noise, developers can:

- Use fan speed control on all fans so that acoustic noise can be minimized when the fans are not required to be at full speed (ordinarily a small percentage of actual usage time). This speed control should be either built into the fan (thermistor-based) or board-level (installed on the motherboard).
- Select the largest fan that will fit for a given required airflow. Fan RPM is proportional to acoustic level, so a larger fan spinning slower will be quieter than a small fan spinning relatively faster to move the same amount of air.
- Pay special attention to balance and any potential obstructions when mounting a fan, since an imbalance or obstruction close to the intake will strongly amplify the emitted sound.
- Select quiet components. There is a wide range of acoustic output among various models and vendors of fans, power supplies, and storage devices, so pay close attention to this in the specification when selecting components.

Note finally that acoustics are a particularly crucial consideration in small form-factor systems, since many of them will be placed not under a desk, but on top of it. This makes it essential that designers estimate acoustic levels early in the design stage so they can make the appropriate tradeoffs in selecting components and setting realistic targets.

One more factor that developers will want to consider is the power supply. For small form-factor systems, developers should consult the "TFX12V [Thin Form Factor] Power Supply Design Guide." This guide describes a standard mechanical profile optimized for small form-factor microATX systems, requirements for a low acoustic profile, and power loading appropriate for typical small form-factor peripheral configurations.

## Summary

As designers and integrators find the need to create small form-factor desktop PCs to reach new markets, an increasing selection of standard components and techniques are available to reach this goal, and are available at the Form Factors Web site. In addition, publications are available to help designers meet the thermal and acoustic challenges while offering their customers the performance, features, and cost they are demanding.

## More Info

Designers who are interested in building small form-factor PCs can learn more from the "MicroATX Small Form Factor System Design Guide" and "TFX12V Power Supply Design Guide." Also available at the site, under the Technologies area, are related publications on EMI and acoustic considerations.

## Author Bio

Greg Schlechter is a senior technical marketing engineer in the Desktop Products Group at Intel Corporation. After working for several years in the design of Intel® platform ingredients, Greg now focuses working with the PC industry on various industry form-factor initiatives and standards. He holds a B.S. in industrial and manufacturing engineering from Oregon State University.

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